Center Innovation Fund: AFRC CIF

Magnetic Active Radiation Shielding System Using Helmholtz Coil Lattices

Completed Technology Project (2017 - 2018)

Project Introduction

The objective of this proposal is to investigate whether a magnetic active radiation shielding systems can be designed from an optics perspective, where Helmholtz coil lattices act as a magnetic lenses that deflect high energy particles away from a spacecraft. Preliminary calculations show that a unidirectional magnetic field generated with Helmholtz coil lattices can be optimized to achieve the minimum level of deflection required to effectively shield against particles of normal incidence within the GCR energy spectrum. Unfortunately this preliminary analysis is far from complete, and doesn't incorporate multiple angles of incidence. It does, however, beg the question of whether extremely large magnetic fields are required to provide an adequate level of deflection. With this idea in mind, this proposal aims to address the following research questions:#1) What is the optimal magnetic field configuration for use in a radiation shielding#2) Can this optimal magnetic field configuration be implemented using Helmholtz coil lattices#3) Can a magnetic active radiation shield be optimized to an extent that it no longer requires the use of high temperature superconductors#This is different from previous active shielding approaches in that it isn't contingent upon the use of high temperature superconductors and large magnetic fields. With that said, its purpose isn't intended to be in direct opposition to high temperature superconductor approaches. Determining an optimal field configuration would be beneficial regardless of whether its implemented with superconductors.

Anticipated Benefits

Despite current research efforts into magnetic active radiation protection systems exist, none of them offers an effective level of protection in a modular form factor and is reliant on the use of superconductors. This project aimed to create a simulation architecture that evaluates a magnetic active radiation shielding configurations that incorporates lattices of Helmholtz coil arrays located at a distance from the spacecraft.

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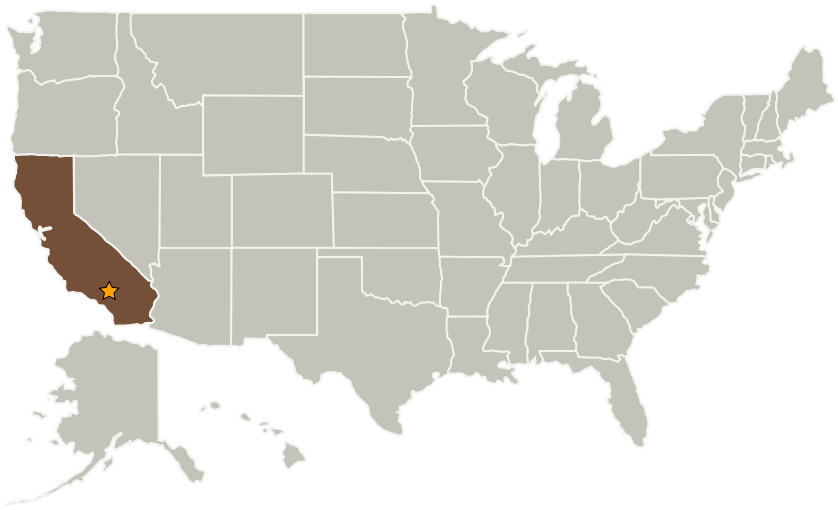
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California

Primary U.S. Work Locations
California

Project Transitions

October 2017: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Center Innovation Fund: AFRC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

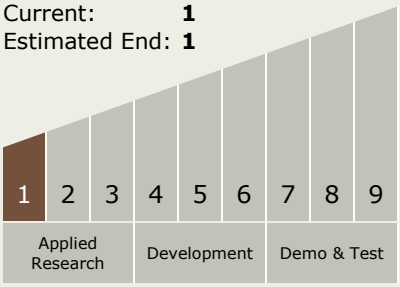
David F Voracek

Principal Investigator:

Matthew R Waldersen

Technology Maturity (TRL)

Start: **1**
Current: **1**
Estimated End: **1**



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September 2018: Closed out

Closeout Summary: Despite current research efforts into magnetic active radiation protection systems exist, none of them offers an effective level of protection in a modular form factor and is reliant on the use of superconductors. This project aimed to create a simulation architecture that evaluates a magnetic active radiation shielding configurations that incorporates lattices of Helmholtz coil arrays located at a distance from the spacecraft. It was learned that individual rows of Helmholtz coil can be configured to have a magnetic field that points in either positive or negative direction depending on the direction of the applied current though each coil. With this concept in mind, the question then changes from how can strong magnetic fields be used to effectively shield astronauts from radiation

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.5 Radiation
    - TX06.5.3 Protection Systems

Target Destinations

Earth, The Moon, Mars